AIRCRAFT CIRCULARS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 26

# THE BOULTON AND PAUL "BUGLE" AIRPLANE

(Day Bomber)

From "Flight," April 23, 1925, and "The Aeroplane," April 29, 1925

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# THE BOULTON AND PAUL "BUGLE" AIRPLANE.*

Day Bomber.

The Boulton and Paul "Bugle" bears a very strong general family resemblance to the "Bourges" and subsequent types, although differing from them in many important respects. This airplane is a twin-engined tractor biplane with the Bristol "Jupiter" engines mounted in the gap between the wings on tubular engine structures (Figs. 1 and 2). As in most Boulton and Paul airplanes, the lower wing is of somewhat smaller chord than the upper, and the aspect ratio is relatively high, i.e., in the neighborhood of 8. The wings are of rectangular plan form with the corners rounded off. Ailerons are fitted to both upper and lower wings, and are balanced by projections working in cut-outs in the main wing tip. The balances are not symmetrical, but have a fairly flat bottom camber and a deeper top camber, the lower wing curve following the contour of the wing section (R.A.F. 15) when the aileron is in the neutral position.

The tail is of normal type, with trimming stabilizer and unbalanced elevator. The rudder, however, has a very large balance, working in a cut-out in the fin. The area of the balance is a very large percentage of the rudder area, and would normally cause over-balancing. Since, however, the balance works in an

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area sheltered by the fin, it does not commence to work until well clear of the fin, and thus for ordinary turning the presence of the large balance does not upset the pilot's steering as it otherwise would. That the rudder and its balance is effective will be realized when it is pointed out that it is actually possible to switch one engine off and to fly not only straight, but actually turning towards the running engine, overcoming the turning moment. Locking devices are incorporated in the rudder operating gear, which enable the rudder to be set permanently over to one side or other while still retaining the movement of the rudder to a sufficient extent. As a matter of fact, a better description would be a spring-loading device, instead of a locking device for, the rudder is not definitely locked; what happens is that levers on each side set the rudder bar to any desired angle, according to the difference in thrust of the two engines, and springs incorporated in the gear enable a further movement to be made. Finally, there is, in the extreme nose of the fuselage, a small hand-wheel operated by the bombing officer, by which very fine adjustment of the rudder is made. This gear forms, as it were, a vernier adjustment of the rudder, and when operative, works independently of the pilot. The question of form, size and disposition of the control surfaces of the "Bugle" have been very carefully gone into, with the result that the airplane is stated to handle particularly well, and to fly very slowly while still being under perfect control.

While on the subject of controls, mention should be made of the fact that the ailerons are mounted in self-aligning ball bearings, so that a slight deflection of the wing spars does not cause them to work stiffly, and furthermore, the ailerons, in spite of their large area, are remarkably easy on the controls and require surprisingly small effort on the part of the pilot, a feature of great importance during a long flight.

Constructionally, the "Bugle" is of fairly normal Boulton and Paul type. An exception is found in the attachments of the inter-wing struts which are now secured to plates straddling the spars. The spars are always in the plane of the wing bracing, and there is thus no offset torque moments. The struts themselves are of highly interesting construction, and are built either of steel or in duralumin. The inner and more highly-stressed struts are of fairly heavy gauge steel. Less severely loaded struts are of thinner gauge steel, while the most lightly loaded struts are of duralumin. Thus, with the same section a wide range of strut strengths is available. Figure 6 shows how the struts are built up, and is self-explanatory. The struts can be built of smaller width for the same strength as a tubular strut or, conversely, for the same width and resistance will be stronger. The fairing is of three-ply wood, and is extremely light. It is slid over the projecting edges of the strut, so that after use the fairing can be slipped off and the strut examined if desired. It is believed this strut construction is protected by a patent.

The Bristol "Jupiter" engines are mounted on tubular structures in the gap between the wings, and each engine is attached to the main engine structure by a swivelling mounting patented by Boulton and Paul several years ago (Fig. 5). This mounting facilitates access to the back of radial engines, and conical or tapered bolts are used so as to take up any wear that might take place. The engines and their supporting structures are enclosed in almost perfect streamline casings, as will be seen from the figures. The fuel supply is by direct gravity feed, there being two fuel tanks, one for each engine, supported underneath the top wing. The tanks are visible in Fig. 3.

The oleo landing gear fitted on the "Bugle" is of particularly robust construction, and has been designed to give exceptional shock-absorbing qualities. Figure 4 with a few words of explanation, may serve to indicate the general principle and construction.

The oleo-pneumatic leg consists, as usual, of two tubes, one of which telescopes inside the other. The lower tube in this case passes inside the upper, and carries at its upper end a piston with small leak holes, and also a spring-loaded valve opening downwards. The lower tube passes, of course, through a stuffing-box in the lower end of the upper tube. Inside the upper, larger-diameter tube, near its upper end, is a diaphragm bolted to the walls of the tube and having leak holes and a spring-loaded valve opening upwards. The tube is filled with oil up to just

above the diaphragm, and air is pumped into the space above the oil to the required pressure. This, of course, is done with the leg fully extended. A neat air pressure gauge is fitted in the upper end of the tube, and has a needle valve arrangement for placing the gauge out of circuit when the landing gear is in use. A jack is then placed under the landing gear and the airplane raised until the leg is extended. The pressure employed is, it is believed, 60 lb. per square inch, and when this pressure has been obtained, the needle valve is screwed down on its seating, and the gauge thus cut off from communication with the inside of the tube.

A somewhat similar telescopic leg (Fig. 3) is employed for the tail skid, and actually the airplane can land and touch with the skid first without causing any damage, so that there does not appear to be much doubt about the shock-absorbing qualities of this form of oleo-pneumatic leg.

The wing section is the ubiquitous R.A.F. 15, but the aspect ratio is high, about 8, and careful streamlining has been carried out wherever possible, such as to landing gear legs, tail skid telescopic leg, and, of course, to the engine housings. Incidentally, it may be of interest to mention that the Boulton and Paul aerodynamics staff has now commenced to calculate wing sections on the Joukowski-Prandtl theory, and have verified certain sections by wind tunnel tests. The agreement between calculated and experimentally-determined values has been found to be excellent.

Performance

| | | |
|---|---|---|
| Maximum speed, | 120 M.P.H. | ( 193 km/hr) |
| Landing " | 56 " | ( 90 " ) |
| Range, | 620 miles | (1000 km ) |
| Climb to 10,000 ft. (3,050 m) | 15.5 min. | |
| " " 15,000 " (4575 ") | 39.0 " | |

Service ceiling 15,500 ft. (4725 m)



Figs. 1 & 2 The Boulton & Paul "Bugle" airplane with 2 Bristol "Jupiter" eng.

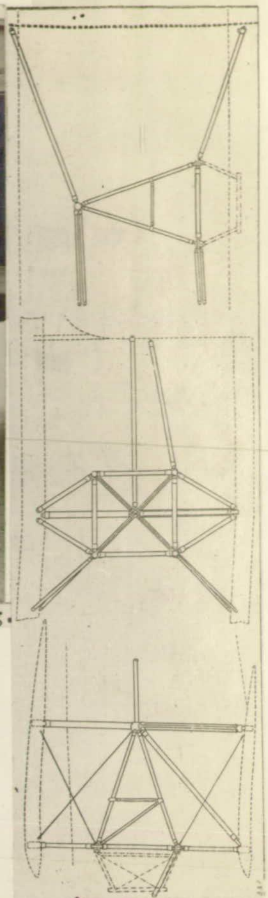

Fig.5 Side and front elevations and plan of tubular engine structure for mounting the Bristol "Jupiter" engines. The actual mountings in front are arranged to swivel so as to facilitate the inspection of the back of the engines.

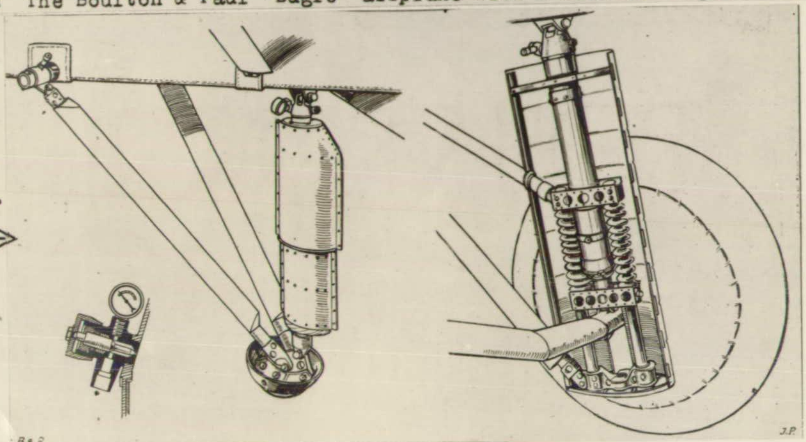


Fig.4 The tail skid and one landing-gear leg. Both are of the oleo pneumatic type. The small inset shows, in section, the air-pressure gauge which can be put in series or out by means of the needle valve. The guage is, of course, in communication with the air in the leg during the process of pumping-up only, or when inspec-ting the pressure in the leg.

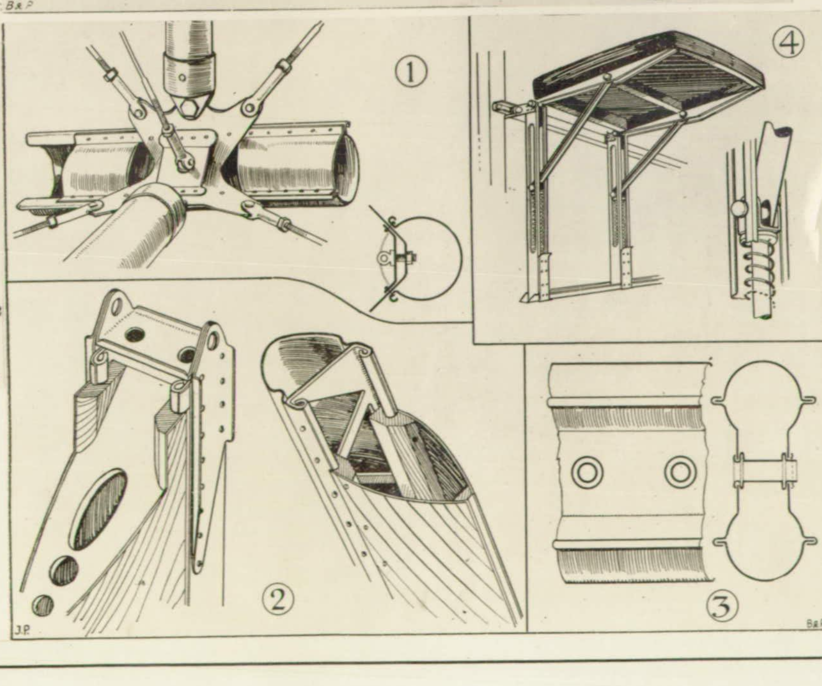


Fig.6 1, details of fuselage construction. 2, the construction of the special inter-plane struts, whose main structure is of metal, while the removable fairing is of three-ply wood. 3, a wing spar section, and, 4, a very light tip-up seat in the forward gunner's cockpit.

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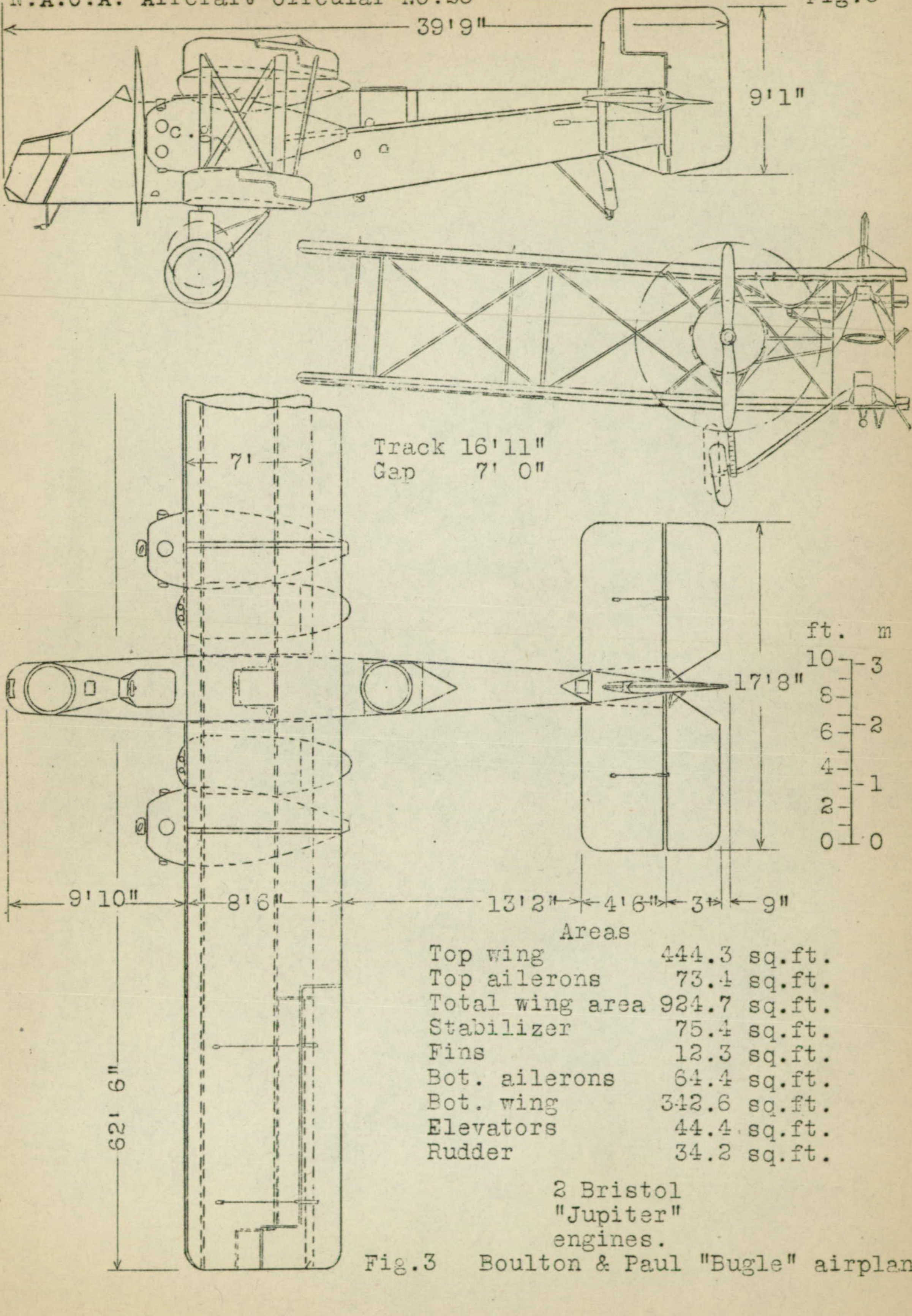


Areas

| | |
|---|---|
| Top wing | 444.3 sq.ft. |
| Top ailerons | 73.4 sq.ft. |
| Total wing area | 924.7 sq.ft. |
| Stabilizer | 75.4 sq.ft. |
| Fins | 12.3 sq.ft. |
| Bot. ailerons | 64.4 sq.ft. |
| Bot. wing | 342.6 sq.ft. |
| Elevators | 44.4 sq.ft. |
| Rudder | 34.2 sq.ft. |

2 Bristol "Jupiter" engines.

Fig.3 Boulton & Paul "Bugle" airplane.